WHAT IS CLAIMED IS:

1. A method of measuring a thickness of every layer of a thin film consisting of a single or multiple layers, comprising steps of:

casting a measurement light onto the thin film;

observing a measured spectrum of an interference light of lights reflected by a front surface of the thin film, reflected by each boundary between the layers of the thin film, and reflected by a rear surface of the thin film, wherein the measured spectrum shows a cyclic curve;

creating a constructed spectrum including a parameter, wherein the parameter has the same dimension as that representing the cyclic curve of the measured spectrum;

calculating the least square error between the measured spectrum and the constructed spectrum;

detecting a local minimum value of the least square error while changing the parameter within a predetermined range; and

calculating the thickness of each layer of the thin film from a parameter yielding the local minimum value, using refractive indices of substances constituting the layers.

2. The method according to claim 1, wherein the measured spectrum is obtained by a wavelength dispersing element and a linear array of photodiodes arranged along the dispersion of the wavelength.

3. The method according to claim 1, wherein the thin film is a multiple-layered film, and the constructed spectrum is created by a linear sum of a plurality of base spectrums each including a parameter representing a cycle interval whose dimension is the same as that of the cycle interval of the measured spectrum.

4. The method according to claim 3, wherein the base spectrums are respectively expressed by the following functions:

$f_0(x) = 1$,

$f_1(x) = x$,

$f_2(x) = (1/x)\sin(\omega_1 x)$,

$f_3(x) = (1/x)\cos(\omega_1 x)$,

...

$f_{2j}(x) = (1/x)\sin(\omega_j x)$, and

$f_{2j+1}(x) = (1/x)\cos(\omega_j x)$,

where j is the number of two-beam interferences produced by different pairs of two light waves.

5. The method according to claim 3, wherein the correspondence between the minimum points and two-beam interferences produced by different combinations of two light waves are determined by a preliminary measurement including steps of increasing the thickness of one of the layers while maintaining the thicknesses of the other layers unchanged, performing the measurement to create another measured spectrum, and comparing the two measured spectrums to identify a minimum point shifting in the direction of the cycle interval, and calculating the thickness of the aforementioned one of the layers from the cycle interval corresponding to the identified minimum point.

6. A method according to claim 3, further comprising steps of externally specifying an assumed range of cycle interval for each minimum point corresponding to the interference produced by each layer.

7. An apparatus for measuring a thickness of every layer of a thin film consisting of a single or multiple layers, comprising:

means for casting a measurement light onto the thin film;

means for observing a measured spectrum of an interference light of lights reflected by a front surface of the thin film, reflected by each boundary between the layers of the thin film, and reflected by a rear surface of the thin film, wherein the measured spectrum shows a cyclic curve;

means for creating a constructed spectrum including a parameter, wherein the parameter has the same dimension as that representing the cyclic curve of the measured spectrum;

means for calculating the least square error between the measured spectrum and the constructed spectrum;

means for detecting the local minimum value of the least square error while changing the parameter within a predetermined range; and

means for calculating the thickness of each layer of the thin film from the parameter yielding the local minimum value, using refractive indices of the substances constituting the layers.

8. The apparatus according to claim 7, wherein the sample film is a multiple layered film, the constructed spectrum is created by a linear sum of a plurality of base spectrums, each including a parameter representing a cycle interval whose dimension is the same as that of the cycle interval of the measured spectrum.

9. The apparatus according to claim 8, wherein the base spectrums are respectively expressed by the following functions:

$f_0(x) = 1$,

$f_1(x) = x,$

$f_2(x) = (1/x)\sin(\omega_1 x),$

$f_3(x) = (1/x)\cos(\omega_1 x),$

$\ldots$

$f_{2j}(x) = (1/x)\sin(\omega_j x),$ and

$f_{2j+1}(x) = (1/x)\cos(\omega_j x),$

where j is the number of two-beam interferences produced by different pairs of two light waves.

10. A method of measuring a thickness of every layer of a thin film consisting of a single or multiple layers, comprising steps of:

casting a monochromatic measurement light onto the thin film;

observing a measured spectrum of an interference light of lights reflected by a front surface of the thin film, reflected by each boundary between the layers of the thin film, and reflected by a rear surface of the thin film while changing a wavelength of the measurement light, wherein the measured spectrum shows a cyclic curve;

creating a constructed spectrum including a parameter, wherein the parameter has the same dimension as that representing the cyclic curve of the measured spectrum;

calculating the least square error between the measured spectrum and the constructed spectrum;

detecting a local minimum value of the least square error while changing the parameter within a predetermined range; and

calculating the thickness of each layer of the thin film from the parameter yielding the local minimum value, using refractive indices of substances constituting the layers.

11. The method according to claim 10, wherein the thin film is a multiple layered

film, and the constructed spectrum is created by a linear sum of a plurality of base spectrums, each including a parameter representing a cycle interval whose dimension is the same as that of the cycle interval of the measured spectrum.

12. The method according to claim 11, wherein the base spectrums are respectively expressed by the following functions:

$f_0(x) = 1,$

$f_1(x) = x,$

$f_2(x) = (1/x)\sin(\omega_1 x),$

$f_3(x) = (1/x)\cos(\omega_1 x),$

...

$f_{2j}(x) = (1/x)\sin(\omega_j x)$, and

$f_{2j+1}(x) = (1/x)\cos(\omega_j x),$

where j is the number of two-beam interferences produced by different pairs of two light waves.

13. The method according to claim 11, wherein the correspondence between the local minimum points and two-beam interferences produced by different combinations of two light waves are determined by a preliminary measurement including steps of increasing the thickness of one of the layers while maintaining the thicknesses of the other layers unchanged, performing the measurement to create another measured spectrum, and comparing the two measured spectrums to identify a local minimum point shifting in the direction of the cycle interval, and calculating the thickness of the aforementioned one of the layers from the cycle interval corresponding to the identified local minimum point.

14. A method according to claim 11, further comprising steps of externally

specifying an assumed range of cycle interval for each local minimum point corresponding to the interference produced by each layer.

15. An apparatus for measuring a thickness of a thin film consisting of a single or multiple layers, comprising:

means for casting a monochromatic measurement light onto the thin;

means for measuring an intensity of an interference light of lights reflected by a front surface of the thin film, reflected by each boundary of the layers of the thin film, and reflected by a rear surface of the thin film;

means for creating a measured spectrum with the measured intensity of the interferance light while changing the wavelength of the measurement light;

means for creating a constructed spectrum including a parameter, wherein the parameter has the same dimension as that representing the cyclic curve of the measured spectrum;

means for calculating the least square error between the measured spectrum and the constructed spectrum;

means for detecting a local minimum value of the least square error while changing the parameter within a predetermined range; and

means for calculating the thickness of each layer of the thin film from the parameter yielding the local minimum value, using refractive indices of the substances constituting the layers.

16. The apparatus according to claim 15, wherein the sample film is a multiple layered film, the constructed spectrum is created by a linear sum of a plurality of base spectrums each including a parameter representing a cycle interval whose dimension is the same as that of the cycle interval of the measured spectrum.

17. The apparatus according to claim 16, wherein the base spectrums are respectively expressed by the following functions:

$f_0(x) = 1$,

$f_1(x) = x$,

$f_2(x) = (1/x)\sin(\omega_1 x)$,

$f_3(x) = (1/x)\cos(\omega_1 x)$,

...

$f_{2j}(x) = (1/x)\sin(\omega_j x)$, and

$f_{2j+1}(x) = (1/x)\cos(\omega_j x)$,

where *j* is the number of two-beam interferences produced by different pairs of two light waves.